SEVERE LOCAL STORMS, OCTOBER, 1929

[The table herewith contains such data as have been received concerning severe local storms that occurred during the month. A more complete statement will appear in the annual report of the chief of bureau]

Place	Date	Time	Width of path, yards [1]	Loss of life	Value of property destroyed	Character of storm	Remarks	Authority
Blackville, S. C.	1			1	$3,500	Tornado	Considerable damage to property over short path; 4 persons injured.	Official, U. S. Weather Bureau.
Atlantic Coast States (central and southern).	1-2					Wind and rain	Heavy damage to crops and property in path of tropical hurricane.	Do.
Oswego, N. Y., and vicinity.	2-3					Wind	Lake-front property and telephone and light wires damaged.	Do.
St. Johns River, Fla. (near mouth).	10				25,000	High winds	British schooner blown ashore, with some damage to vessel.	Do.
Beckham County, Okla. (northwestern).	11	4:30 p. m.	3,520		35,000	Hail	Considerable damage to crops and other property over path 10 miles long.	Do.
Clinton, Tex. (near)	15	2-3 p. m.	3 mi.			do	Young crops destroyed; roofs, windows, and auto tops damaged; path 5 miles.	Do.
Pennsylvania (central)	21-22	4-10 p. m.				Wind and rain	Shamokin Airport damaged; wire service of all kinds impaired; trees uprooted; crops injured.	Do.
Lake Huron and Lake St. Clair (shores of).	21-23			1		Wind	4 large boats driven ashore, some in bad shape, with cargoes total loss; much damage to waterfront property.	Do.
Lake Michigan (southern shores of).	22-24			46		do	Several million dollars' damage to lake-front property and shipping; car ferry Milwaukee sunk, causing considerable loss of life.	Do.
Illinois (northern) and Wisconsin (eastern).	28-29			10		do	Steamship Wisconsin foundered, causing loss of life; heavy damage to parks, buildings, and other property on lake front.	Do.
Anderson, Tex. (near)	30		50			Tornado	Schoolhouse wrecked	
Houston, Tex. (vicinity of)	30				5,000	Series of tornadic storms.	Some damage to property; 4 persons injured	Do.
Rylie and Elam, Tex. (near).	30	4-5 p. m.				Wind and hail	Several homes damaged; a number of outbuildings wrecked.	Do.

[1] Mi. signifies miles instead of yards.

RIVERS AND FLOODS

By R. E. SPENCER

Excepting the few slight rises of the 22–24th, all floods in October were more or less direct results of the tropical storm which crossed the extreme southeastern United States and moved northward along the Atlantic seaboard during the first few days of the month. This storm is fully described elsewhere in this review. The resultant rains were practically continuous from September 20 to October 1 in the South Atlantic and East Gulf sections, and during the first two days of October in the Middle and North Atlantic States and the extreme eastern Ohio Valley, with a distinct division, in the Southeast, into two periods, both of which culminated in extremely heavy falls—one on September 26–27 and the other on September 30–October 1.

These two rain periods, the fall in either of which would have been sufficient to produce floods in the rivers of the Southeastern States, were especially effective in combination—the first having brought many of the streams to flood stage in late September and the second, following while they were still high, causing serious overflows.

Most conspicuous among these was the flood, or double flood, in the Savannah River at and below Augusta, Ga. In his report on the first portion of this disastrous rise Mr. E. D. Emigh, the official in charge of the Weather Bureau office at Augusta, pays particular attention to the amount and distribution of the rainfall. He computes the average depth over the Savannah River drainage area (7,294 square miles) for the 34-hour period ending at 8 a. m. September 27, as 8.84 inches and points out that by far the greater part of the rain fell in the central and lower portions of the basin. This meant, of course, that the comparative lightness of rain in the upper basin must have been balanced by a corresponding excess in the middle and lower parts; and the result was that while river stages in the upper basin (specifically at Carlton, Ga., and Calhoun Falls, S. C.) were not extraordinarily high, the river in the central and lower portions reached the highest stages of record.

A suggestion of the rapidity and magnitude of this rise is given in the following extract of Mr. Emigh's report:

At Augusta on the evening of September 25 the Savannah River was at a 10-foot stage, with a discharge of approximately 10,000 cubic feet per second. In 24 hours there was an increase in stage to 33.1 feet and a discharge of 100,000 cubic feet per second. At the end of 48 hours the river, at a crest of 46.3 feet, was carrying thirty-seven times as much water as at the outset and was discharging 370,000 cubic feet per second—the greatest discharge ever known to have passed the city. Warnings of the approach of the flood were of course distributed by every available means, and while considerable nervousness was inevitable there was a fairly general local assurance that the levee could be depended upon to protect the city. This confidence was justified, for the main portion of the levee proved adequate both in capacity and stability to withstand the test. About 3 miles below the city, however, a breach occurred. Fortunately, the break did not attain great width until after the river had fallen considerably from the crest stage. The situation was somewhat relieved by the city engineers, who opened the outlet gates at the mouth of Butlers Creek, and by two breaches in the levee near the Butlers Creek gates. Backwater, however, overflowed much farm land and flowed into the lower sections of the city to a depth of 2 to 4 feet. Since the houses in the area affected were built well above the ground in prelevee days, no great harm was done. Ample warning of the approach of the backwater had been given by the city engineers and disseminated by them, by the newspapers, and by the Weather Bureau office.

In the second portion of this flood (crest 45.1 at midnight of October 2) the rainfall distribution over the Savannah River Basin was more regular and somewhat less heavy than in late September. A comparative table of amounts follows, the stations being arranged in the order of their distances from Augusta:

	34 hours ending 8 a. m. Sept. 27	30 hours ending 6 p. m. Oct. 2
Augusta, Ga.	7.78	9.98
Double Branches, Ga.	14.51	9.80
Edgefield, S. C.	7.84	8.26
Warrenton, Ga.	9.16	6.75
Greenwood, S. C.	9.83	9.02
Washington, Ga.	14.49	9.68
Calhoun Falls, S. C.	9.48	8.30
Carlton, Ga.	7.67	7.12
Gillsville, Ga.	5.95	8.15
Anderson, S. C.	5.50	5.83
Toccoa, Ga.	5.03	4.30
Average	8.84	7.93

The lowest stage reached at Augusta following the crest of 46.3 feet on September 27, was 21 feet late on the

30th—11 feet higher than the stage from which the first flood had begun; so that the extremely heavy rain of September 30–October 1 rendered it immediately evident that a second rise of rapidity and magnitude closely comparable with the first would occur. No great damage had resulted in the city from the first rise; but the levee, softened by the abundance of rain and high water, had been seriously weakened by slides at several points, so that the prospect of this second major flood was considerably more threatening than that of the first had been. The gravity of the situation is sufficiently suggested by the strenuous efforts made by the city to cope with it. The crest forecast, issued at 7 p. m. of October 1, was immediately published in a special edition of the Augusta Chronicle, and while police and fire departments directed the exodus from threatened portions of the city to the hill sections, a small army of volunteers and conscripts was organized for levee-protection work. By 2 a. m. this work, under the direction of Mr. Ralph S. Howard, of the United States Engineer office, and his associates, Mr. T. S. Gray, chairman of the levee commission, and Mr. Elroy G. Smith, was under way; and, in spite of the difficulties imposed by darkness, a rapidly rising river, and a steady downpour of rain, by 8 a. m. the levee had been successfully repaired at its least dependable points. The river, already 10.8 feet above flood stage, continued to rise until the crest of 45.1 feet was reached at midnight of October 2, with the levee still intact except at the point of its break during the first flood.

In reporting on stages and discharge Mr. Emigh remarks:

Although the crest stage reached on October 2 was but 45.1 feet, as against 46.3 feet on September 27, discharge measurements at Stevens Creek power dam disclosed the fact that the discharge in the October flood was 382,000 cubic feet per second, as against 370,000 in the September flood. The fact that the river carried more water at a lower stage was due to the removal by the first flood of the Hamburg Road embankment, and in some degree to the clearing away of other obstructions further downstream in the same manner, particularly the Charleston & Western Carolina bridge approach.

The two floods merged below Augusta, resulting in an immense accumulation of water in the delta and swamp land of the Coastal Plain. While the Weather Bureau maintains no gages on this reach of the river, it was found possible to make satisfactory forecasts of flood heights at crucial points. This information proved of a special value to railroads, the State highway commission, and the United States Engineer officer supervising precautionary measures in Savannah, Ga., and elsewhere along the lower reaches of the river.

The following discussion of damage and losses is taken from Mr. Emigh's report:

Backwater from the break in the levee covered an extensive area of farm lands, the city cemeteries, May Park, and about 40 city blocks in the low-lying southeastern portion of Augusta, extending to Union Station and the Federal building. The depth of the water was 2 feet greater than in September. On the lower farm lands it was over 15 feet deep and at lowest points in the city 8 to 10 feet deep. Aside from filling cellars of business houses and churches and creating a situation that called for a sanitary clean-up, the damage in the city was not great. On the farms there was total loss of crops, including stacked and stored hay and other property, while considerable numbers of cattle, mules, and hogs were drowned, and houses, barns, cabins, and farm equipment were carried off, destroyed, or seriously damaged. Advance warnings prevented loss of human life, but the deluge of rain and resulting flooded condition of land and roads prevented the saving of property.

Railways, highways, and bridges suffered so severely that no traffic moved into or out of Augusta for several days after the second flood, which completed the devastation efficiently begun by the first storm, from which only partial recovery had been possible. Conditions were considerably aggravated in many places on both sides of the Savannah River by the breaking of the dams of practically all of the numerous fishing and bathing ponds, and of eight of the power dams in the Horsecreek Valley, in South Carolina. Fortunately the absence of heavy winds prevented the complete destruction of corn, cotton, and other standing crops outside the actual flood areas, but over hundreds of square miles of inundated area the losses to agriculture were complete, including in many cases harvested crops, equipment, and buildings. Difficulty was experienced in protecting the Coastal Highway, in South Carolina, 25 miles from the normal channel of the Savannah River, while the lower Ogeechee River overflowed the same highway, in Georgia, for a distance of 3 miles. The loss of livestock over these flooded areas was undoubtedly very great, since the swampy nature of the country and its inaccessibility under storm conditions prevented precautionary measures.

The industrial concerns along the river opposite Augusta experienced heavy losses, the brickyards being deeply submerged and frame buildings of all sizes being wrecked and carried away. Many of the houses in Hamburg, also opposite Augusta, were carried away and the negro occupants rendered homeless for the time being.

Replacement of damaged parts of the Sandbar Ferry highway bridge below Augusta will cost $150,000, while two spans of the City Bridge, at Fifth Street, were swept away and a railroad bridge lost two massive steel spans. At the Thirteenth Street Bridge only the approach on the Carolina side was damaged and the bridge was put back into use promptly.

Losses in Augusta were due to storm damage and the effect of the backwater. Many streets in the hill section were badly torn up, while breaks of considerable length occurred in the banks of the city power canal.

Total damage in the city and to city property was probably about $275,000. County roads and bridges, including Sandbar Ferry, suffered to the extent of $500,000, while the loss to the agricultural interests in this, Richmond County has been placed at $175,000. Total damage in North Augusta and Hamburg is estimated at $200,000, while elsewhere in Aiken County storm and flood damage to public and private interests must have amounted to at least $400,000. In Columbia County, Ga., above Augusta, agriculture suffered a loss exceeding $200,000, and roads and bridges were undoubtedly damaged to a like extent. Losses in Georgia and South Carolina in counties contiguous to the Savannah River must have aggregated in the neighborhood of $5,000,000 to public, corporation, and private property. This may reasonably be considered a low estimate.

The value of property saved through Weather Bureau warnings is roughly estimated at $1,000,000.

To the north and south of the Savannah, the floods in the Santee and Altamaha systems and in the rivers of North Carolina were the only ones of importance. Along the Santee and Altamaha the rain causing the rises occurred, as in the Savannah drainage area, in two falls—the first on September 26–27 and the second during and immediately following September 30. The rises resulting from the first fall had not, of course, had time to recede when the second occurred; so that crests considerably above flood stages were reached in both systems. Losses in the Altamaha Basin are estimated to have reached $500,000, and those in the Santee $1,097,330, distributed as follows:

Tangible property	$894, 850
Matured crops	82, 980
Prospective crops	100, 400
Livestock	2, 575
Suspension of business	16, 525
Value of property saved by warnings	160, 315

The distribution of flood losses comprised the whole of the basins below Pelzer and Gaston Shoals, S. C., and Mount Holly, N. C., but the region along the Santee and west of the Catawba-Wateree suffered the major portion of the losses.

The Cape Fear River flood and those in the Neuse and Tar Rivers of North Carolina are reported upon by the official in charge of the Weather Bureau office at Raleigh, N. C., as follows:

The Cape Fear flood was the third heaviest of record; it was slightly less so than the flood of last year at Fayetteville and Elizabethtown, but heavier at Moncure, the rainfall being heaviest in the drainage area above Moncure and falling off sharply toward

the coast. The flood in the Neuse reached 0.2 foot above the high-water mark at Smithfield on the 4th, but was a foot under the high record at Neuse, N. C., and was reported about 18 inches below the high mark in the lower portion at Kinston. The rainfall was the heaviest in the middle watershed, the amount at Raleigh being the greatest of record for the length of time. Floods in the Tar and Roanoke were heavy, but not close to record floods.

Warnings were of much value to many interests, especially in the middle and lower portions of the rivers. Damage was not nearly as heavy as during the floods of last year for two reasons: First, the overflow occurred later in the season when crops were practically matured and partly harvested or ready to be harvested; second, less rain occurred in the lower sections, and with clear weather following the rain for a week or more there was ample time to move crops, stock, and other property to places of safety. One instance may be mentioned, for example, where a farmer in Wayne County employed 100 hands and 40 wagons or trucks and harvested his entire crop on 2,000 acres of land in advance of the flood.

The rise in the Cape Fear at Fayetteville from 5 feet at 8 a. m. of October 1 to 46 feet at 8 a. m. of October 2, 41 feet in 24 hours, is a record change for this district. One instance is mentioned here where by quick action one plant saved goods valued at $10,000. Losses sustained were as follows:

Tangible property	$200,000
Livestock, and matured and prospective crops	500,000
Suspension of business	100,000
Value of property saved by warnings	350,000

Other Atlantic and East Gulf drainage floods were moderate, or at worst not particularly serious. A loss of $30,000, of which $14,000 was in crops, occurred in the Pedee system of South Carolina (savings through flood warnings, $257,000); and damage to the extent of $36,500 was done on the Choctawhatchee River at Geneva, Ala., and Caryville, Fla. (savings through flood warnings, $3,000).

In the Ohio Valley rainfall was especially heavy over the Monongahela and lower Allegheny Basins; but, owing to the extreme dryness of the ground, and in some measures to the lowness of the streams themselves, the effectiveness of the rain was materially reduced and the floods of little consequence. The total loss was about $10,000.

No other damage is reported in the Ohio drainage basin except $5,000 to corn along the Kanawha River.

River and station	Flood stage	Above flood stages—dates From—	To—	Crest Stage	Date
ATLANTIC DRAINAGE					
	Feet			*Feet*	
Schuylkill: Reading, Pa	10	2	2	10.0	2
James: Columbia, Va	18	3	3	18.0	3
Roanoke:					
Randolph, Va	21	3		28.8	4
Weldon, N. C	30	2	8	45.6	6
Dan:					
Danville, Va	8	2	4	11.6	3
Clarksville, Va	12	3	5	15.1	5
Tar:					
Rocky Mount, N. C	9	1	7	13.0	3
		22	26	13.4	23
Tarboro, N. C	18	3	11	26.6	7
		24	30	25.5	27
Greenville, N. C	14	4	12	19.7	8–9
		25	31	18.8	29
Fishing Creek: Enfield, N. C	15	3	5	16.3	4
		23	25	16.2	24
Neuse:					
Neuse, N. C	15	1	8	23.7	4
		22	22	16.0	22
Smithfield, N. C	14	1	10	26.5	3
		22	24	18.5	23
Cape Fear:					
Fayetteville, N. C	35	2	7	64.1	4
Elizabethtown, N. C	22	2	10	38.9	6
Haw: Moncure, N. C	22	1	4	33.0	2
Peedee:					
Cheraw, S. C	27	2	6	39.8	4
Mars Bluff, S. C	17	3	14	27.3	7
Poston, S. C	18	6	17	26.5	10
Lynches: Effingham, S. C	14	6	10	19.4	7
Santee:	*Feet*			*Feet*	
Rimini, S. C	1	2 (1)	(2)	31.8	6
Ferguson, S. C	12	1	(2)	21.0	7
Jamestown, S. C	12	7		29.1	11–12
Catawba:					
Mount Holly, N. C	15	2	3	19.0	3
Catawba, S. C	12	2	4	28.7	3
Wateree:					
Camden, S. C	24	2	5	36.0	3
Malta, S. C	14	4	7	18.0	6
Congaree: Columbia, S. C	15	2	6	33.1	3
Broad: Blairs, S. C	15	1	5	39.5	3
Saluda:					
Pelzer, S. C	7	1	4	11.6	2
		22	23	8.6	22
Chappells, S. C	14	(1)	6	30.7	2
		23	24	17.9	24
Savannah:					
Calhoun Falls, S. C	6	1	3	10.1	2
Augusta, Ga	32	1	4	45.1	2–3
Broad: Carlton, Ga	11	1	3	27.0	2
Altamaha:					
Charlotte, Ga	15	(1)	17	25.2	9–10
Doctortown, Ga	10	2	16	11.2	12–13
Everett City, Ga	10	(1)	23	15.1	14
Oconee:					
Milledgeville, Ga	22	1	5	37.0	2
Dublin, Ga	22	3	9	27.6	5
Ocmulgee:					
Macon, Ga	18	1	4	25.1	3
Hawkinsville, Ga	25	4	8	30.6	6
Abbeville, Ga	11	2	13	17.4	8
Lumber City, Ga	15	4	14	20.0	10–11
EAST GULF DRAINAGE					
Apalachicola:					
River Junction, Fla	20	4	6	21.4	5
Blountstown, Fla	20	4	9	21.9	6
Flint:					
Montezuma, Ga	20	4	5	20.3	4
Albany, Ga	20	3	10	25.3	5
Chattahoochee:					
Eufaula, Ala	40	2	3	47.0	2
Alaga, Ala	30	2	4	39.1	3
Choctawhatchee:					
Geneva, Ala	23	2	5	[3] 26.9	3
Caryville, Fla	12	2	9	14.9	4
MISSISSIPPI DRAINAGE					
Tygarts: Philippi, W. Va	20	3	3	22.0	3
Monongahela:					
Lock No. 15, Hoult, W. Va	22	3	3	25.0	3
Lock No. 7, Greensboro, Pa	30	3	3	36.5	3
Lock No. 4, Pennsylvania	31	3	4	35.4	3
McKeesport, Pa	16	3	3	16.2	3
Little Kanawha: Glenville, W. Va	23	3	3	23.9	3
New:					
Ivanhoe, Va	15	2	2	20.0	2
Radford, Va	14	2	2	18.5	2
Glenlyn, Va	11	3	3	14.8	3
Elk: Clay, W. Va	18	3	3	23.0	3
Scioto: Larue, Ohio	11	23	24	11.4	24
French Broad: Asheville, N C	4	1	3	6.0	2
		22	22	4.8	22
Big Pigeon: Newport, Tenn	6	2	2	7.6	2
Nolichucky: Embreeville, Tenn	10	22	22	10.6	22

[1] Continued from last month. [2] Continued at end of month. [3] Estimated.

THE EFFECT OF WEATHER ON CROPS AND FARMING OPERATIONS, OCTOBER, 1929

By J. B. KINCER

General summary.—The first decade was generally favorable for seasonal farm work, although there was some delay by heavy rains in the Atlantic States and a few interior sections. In parts of the central and southwestern winter-wheat belt rain was needed, but the soil was in rather favorable condition over much of the country. There was no material frost damage and, while late fall crops matured rather slowly due to cool weather, fair progress was made.

During the second decade dry, sunny weather in the Southeast made favorable conditions for crops and field work, while generous rains in some of the dry sections of the winter-wheat belt were very beneficial, although more moisture was needed locally in the Lake region.

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